2001

Towards a Cleaner Marine Environment

Miljøstyrelsen
Miljø- og Energiministeriet

Contents

1 Clean sea by 2020

Life originated in the ocean and we humans have never relinquished our close bond to it. Its natural beauty and resources make the sea vital to Denmark, which is surrounded by a 7,300-km coastline. No point in Denmark is further than 50 km from the nearest sea or fiord. The sea also forms a completely natural link to the world around us.

Now, however, the marine environment is threatened. Its flora and fauna are threatened by an influx of nutrient salts and substances hazardous to the environment. Pollution by oil is also a typical black spot on our sea charts and demands an active effort. This pamphlet is about the sea and addresses all who take an interest in the marine environment. The pamphlet outlines the mosaic of activities under the sea, on its surface and along our coast that together affect the state of the marine environment. By reading it, you will gain an insight into many of the activities and conditions that are part of the Danish EPA's work towards a cleaner, more sustainable marine environment. The pamphlet does not discuss marine nature conservation.

The Danish Government's goal is an unpolluted sea by 2020, one which we can safely hand down to our children and grandchildren. International collaboration on the marine environment is crucial, if we are to attain this goal within one generation.

2 Marine resources in great demand

The sea holds vital natural resources and great commercial potential, both of which demand consideration for the marine environment. Fishery has been an important industry for millenia, but fishing quotas and controls are necessary today, to avoid overfishing and ensure a sustainable marine ecosystem.

The magnitude of oil and gas extraction from the North Sea has attained proportions that exceed Denmark's total energy consumption. The obverse side of the coin is that such large-scale extraction can damage the marine environment. Oil and gas production causes oil spills and the loss of chemically-contaminated drilling fluid (or mud), which is why such production must be considerate of the environment.

Fresh winds blow freely and frequently across the sea. At the time of writing, wind turbines are planned for five locations just a few kilometres from the shore, as an ecologically-sound supplement to Denmark's energy supply. But these generators can disturb bird and animal life and affect important fishing grounds, or cause visual disturbance. For these reasons, careful thought must be given to the siting of wind turbines at sea.

2.1 The sea as a transport route

As a transport route, the sea forms a vital link between our provinces and the world outside. Shipping has been of major importance since the days of the Vikings. Today, high-speed ferries, container ships, oil tankers, etc., sail in and out of Danish waters, with all the disturbances that they bring, such as the toxins released from their bottom paint, waste, oil spills at sea and noise. Shipping demands fairways and harbours, in which the dredging and depositing of sea-bed material leave their traces.

Bridges are another form of transport route at sea. The Great Belt and Øresund bridges made the 1990s the decade of bridges. Bridge building affects the sea-bed and can change the currents, and consideration for the environment is therefore an integral part of bridge building.

2.2 Pollution from land

The greatest impact on the marine environment has its origins in our activities on land. Nitrogen that leaches out from agriculture, in particular, affects the conditions of the marine flora and fauna. A large part of the environmentally-harmful substances that result from waste incineration and industrial manufacturing also end up in the sea and, despite effective sewage treatment plants, the waste water from our urban areas is not free of heavy metals and other environmentally-harmful substances. All of these activities constitute a burden on the sea and effective legislation is necessary, if we are to secure a healthy marine environment.

Denmark has committed itself through national and international agreements to continual monitoring of the state of the environment and to taking the initiatives needed to secure our marine environment.

3 No limits to marine pollution

Various chemicals, which can affect and harm the marine environment, are constantly flowing into the sea. These substances mainly originate in human activities, from our everyday housekeeping, to agriculture, industry, traffic and energy production.

This pollution does not solely come from Denmark, but also from other countries. Perhaps the smoke from Danish chimneys ends up in the Gulf of Bothnia, while the Baltic Sea receives, for instance, contaminated river water and atmospheric fallout from East Europe. If our efforts are to be successful, the pollution of the sea must be curbed also at the international level.

Fortunately, many substances that end up in the sea are innocuous in the environment, as micro-organisms and other natural processes degrade them rapidly. They can, however, disturb the balance between the different animal and plant species. But other substances - even at extremely low concentrations - only degrade with difficulty and are suspected of harming animal life and people. The environmental authorities' monitoring of the marine environment obviously keeps an eye on the most dangerous substance groups, for instance heavy metals and such poorly degradable organic substances as PCBs (polychlorinated biphenyls), pesticides, softeners for plastics, TBT (tributyltin) and the PAHs (polyaromatic hydrocarbons).

3.1 Fewer heavy metals in Danish harbours

The sea is primarily contaminated by heavy metals through atmospheric fallout and discharges from urban areas and industry. Once in the sea, most of the heavy metals become bound to particles in sediment. But a small quantity becomes dissolved in the water and can spread widely in marine food chains. Cadmium and mercury are the two heavy metals that accumulate in this way, and they are toxic to aquatic organisms and humanity alike.

Heavy metals also occur naturally in the environment. Such natural occurrences are called the background levels. Our goal for the Danish marine environment is to reduce the concentrations of heavy metals to values close to the background levels. Fortunately, sampling reveals that, with the exception of cadmium, concentrations of heavy metals are dropping in Danish waters and, in many places, are approaching their background levels. Certain places, such as Øresund and a few of the inner fiords, still exhibit levels high enough to affect aquatic organisms.

3.2 Spotlight on PAHs from oil

PAHs are substances that occur in oils and are formed during the combustion of fossil fuels (coal, oil and gas). Oil spills from shipping, oil extraction and spillage from industrial processes at sea are the main sources of PAHs in the marine environment, although about a quarter of the sea's PAHs originate in land-based combustion processes.

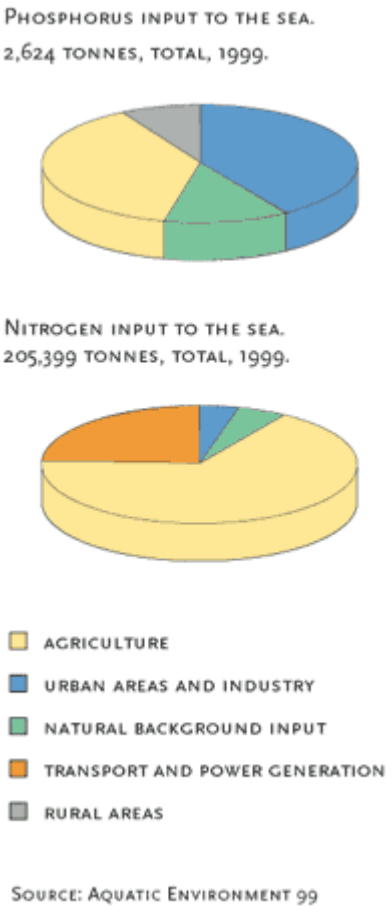
Many PAHs are acutely toxic to aquatic organisms and other types of PAH can act as carcinogens and cause changes in the genetic material of man and animals. Most aquatic organisms can, however, metabolise the substances and excrete their metabolites, which limits the extent of their accumulation in the food chain.

Monitoring of PAHs in our coastal waters shows that the general PAH level is low. But levels harmful to fish and small animals have been found in fiords, where water exchange only occurs slowly, or where major point sources of contamination are located. For this reason, the environmental authorities have redoubled their efforts to prevent the occurrence of all types of oil pollution in our waters.

Point sources and diffuse sources Marine pollution has two origins, i.e., point sources and diffuse sources.
Point sources: pollution from particular sites. Discharges of waste water from sewage treatment plants and industry, as well as from watercourses, are particularly common point sources. Other point sources include, e.g., sea farms, depositing of sea-bed material and oil spills from shipping and drilling platforms.
Diffuse sources: leaching from the land, such as nitrates from fields, and atmospheric fallout, in which substances in chimney smoke are bound to dust or water particles and sooner or later precipitate.

4 Nutrients leave the sea breathless

Nitrogen and phosphorus are nutrients that promote the growth of algae. This leads to vigorous algal growth, oxygen depletion and, in the worst case, fish mortality - especially in the inner Danish waters. Too many nutrients also impoverishes marine flora and fauna, for instance, by massive occurrences of sea lettuce. Nitrogen is the prime cause of such problems.



Agricultural fertiliser runoff is the major source of nitrogen in the marine environment. The nitrogen surplus is leached out of the fields as nitrates and ends up in the aquatic environment. At the same time, ammonia evaporates from the fields and a large part of it becomes dissolved in rain and also finishes in the sea. The combustion of coal and oil, including that consumed by traffic, also contributes to atmospheric fallout. Discharges of waste water also used to contribute large quantities of nitrogen to the sea, in the late 1990s, modern sewage treatment plants brought this contribution down to about 2.5 percent of the total, in contrast to more than 10 percent at the end of the 1980s.

4.1 Danish waters plagued by oxygen depletion

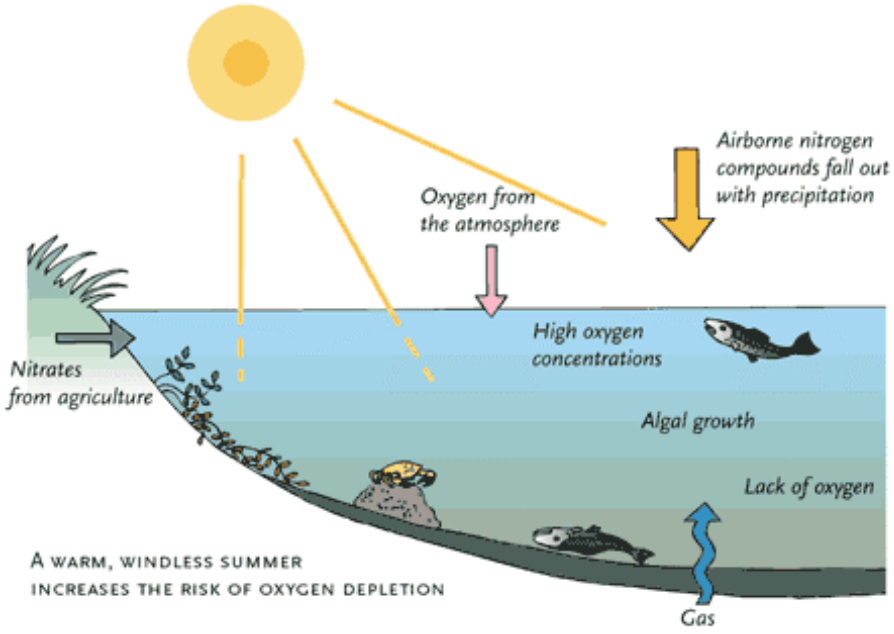
A large pool of nutrients accumulates in the sea during the winter, because the algae do not grow, and, therefore, do not consume nutrients at their normal rate, due to the lack of light. As soon as the quantity of light increases in the early spring, this nutrient pool promotes rapid algal growth. Much of the ensuing algal bloom later sinks to the sea-bed, and is degraded by micro-organisms and sea-bed fauna, with the accompanying consumption of oxygen and risk of oxygen depletion. This has major consequences for all life in the sea.

4.2 Wind and weather determine oxygen depletion

Whether or not leached nitrogen results in oxygen depletion is highly dependent on the climatic conditions. A mild wet winter causes severe leaching and, thus, lays the foundation for high algal growth in the spring. Without wind, the oxygen-rich water at the top of the water column cannot mix with the depleted water at the bottom. In serious cases, the water's oxygen content can become so low during the summer that sea-bed fauna cannot respire. Some creatures, such as fish, attempt to flee but can be trapped in pockets of water that contain little oxygen, where they suffocate. At this time, there is also a risk of sediment disturbances, in which such toxic gases as hydrogen sulphide bubble up from the sea-bed and kill all life in their path.

4.3 Poisonous algae can necessitate bathing bans

Warm and relatively windless summers increase the risk of algal bloom (especially marine blue-green algae, some of which are toxic). Fish are particularly exposed, partly because the toxic algae infest their gills. Some algal species are also toxic to humans. The authorities advise against bathing, when such colonies of algae approach the coast and bathing beaches. Ingestion of or contact with poisonous algae can typically cause vomiting and eczema.



A WARM, WINDLESS SUMMER INCREASES THE RISK OF OXYGEN DEPLETION

5 Stricter environmental requirements and monitoring

Much has been done to improve the Danish marine environment over the last couple of decades. Large sums have been invested in modern sewage treatment plants, which means that the waste water from our urban areas is now effectively purified. The environmental requirements set on industry are significantly more stringent, e.g., in the form of stricter requirements on discharges and stricter controls, and the most dangerous substances are now totally banned. Other measures used in the struggle against undesirable substances are, e.g., taxes, ecolabels and voluntary agreements with industry on phasing out the use of substances harmful to the environment.

With respect to agriculture, special efforts have been made to limit nitrogen leaching in an attempt to prevent the frequent occurrence of oxygen depletion. The *Folketing* (Danish Parliament) adopted Action Plan for the Aquatic Environment I in 1987. This plan was intended to limit nitrogen leaching to 50 percent before 1993. The target was not attained. The *Folketing* therefore adopted Action Plan for the Aquatic Environment II in 1998.

5.1 Monitoring of the aquatic environment

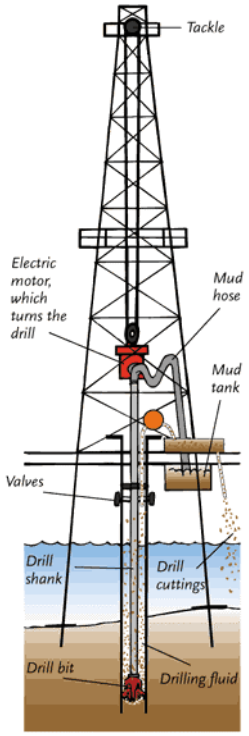
Continual monitoring of the marine environment is decisive in determining whether current environmental action is sufficient or whether new initiatives are necessary. The environmental authorities launched a very extensive national monitoring programme in 1988, focusing on nutrients in all parts of the aquatic environment (groundwater, watercourses, lakes and the sea). NOVA 2003 (Danish acronym for "National Programme for Monitoring of the Aquatic Environment"), was extended in 1998 to include heavy metals and substances harmful to the environment. The results obtained in 1999 show that, in exposed areas, the occurrence of individual substances that are harmful to the environment and continuing nitrogen leaching give reason for concern.

6 Oil and gas extraction at sea

Oil and gas are extracted through pipes extending seven to eight km down into the earth's crust, at depths of down to 60 metres in the Danish sector of the North Sea. Production has increased rapidly since the first oil was brought to the surface from Danfield in 1972. About 40 platforms, distributed over 16 oil and gas fields, are in operation today. Production exceeded the Danish consumption of oil and gas for the first time in 1991. 1999 was also a record year, in which production exceeded Denmark's total energy consumption by 12 percent. Although North-Sea oil gives the Danish state a generous income, oil production also has an impact on the marine environment. Drilling fluid and produced water are the primary causes of ecological problems.

6.1 Drilling waste can pollute

Drilling waste (which is discharged into the sea after partial purification) occurs during drilling operations. This drilling waste consists of the drill cuttings and the drilling fluid, which is pumped down through the drill itself, during drilling and which contains various chemical additives. The drilling waste contains residues of the drilling fluid, in the form of minerals, chemicals and traces of heavy metals. Drilling fluid is used to lubricate and cool the drill bit and, by virtue of its weight, to prevent blow-out, in which oil and gas erupt violently when the drill penetrates an oil pocket. The mud is squeezed out through holes in the drill bit, from which it is forced back up to the platform within the jacket of the drilling pipe, together with the drill cuttings.

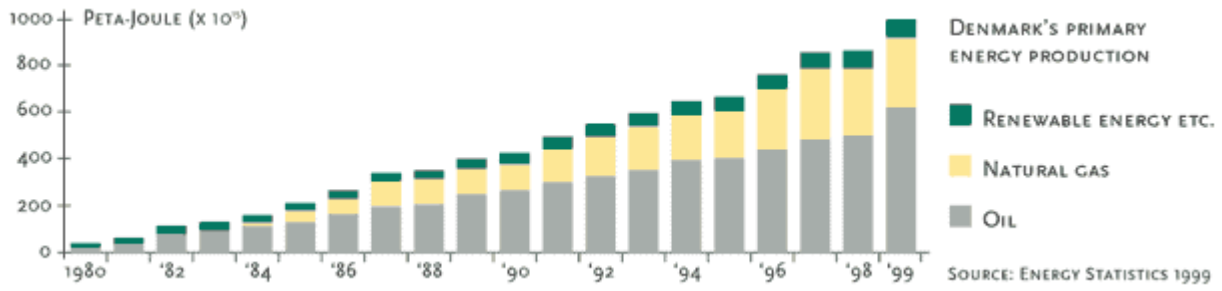


6.2 Oil residues in produced water

The oil and gas extracted from wells contain a certain amount of water. This "produced water" is separated out on the platform and purified according to a set of rules, before it is discharged into the sea. But produced water still contains oil residues, which amount to an annual total of over 200 tonnes (1999) and which are discharged into the North Sea from Danish oil fields. This quantity of water has been increasing in recent years, in part because of increased production. Produced water also contains chemicals used in the process. Some of these chemicals can probably affect the marine environment.

6.3 Environmental requirements on the off-shore industry

The off-shore industry's impact on the marine environment is monitored continually. Investigations show that the effects on the sea-bed around platforms include e.g. the high hydrocarbon content of the sediment and the paucity of life on the sea-bed. For this reason, the environmental authorities regulate the off-shore industry to ensure that its production is environmentally acceptable. The guiding principle is that only the best available technology be used. Just now, the goal is to reduce the oil content of the produced water through improved purification. At the same time, there is an on-going transition to chemicals less hazardous to the environment.



7 Bridges from coast to coast

The construction of the bridges over the Great Belt and Øresund gave cause for grave concern on behalf of the environment. The most crucial environmental requirement was the so-called "zero-solution", i.e. bridge construction that did not disturb the currents flowing into the Baltic Sea from the Great Belt and Øresund. The Great Belt and Øresund both constitute corridors between the salty Kattegat and the sweeter water of the Baltic Sea. Any reduction in water exchange would reduce the salt content, and, therefore, the oxygen content, of the Baltic Sea and would alter its ecological balance.

The zero-solutions found for both of these major projects enabled us to avoid any detrimental impact on the Baltic Sea. A total of about 18 million m³ of sea-bed was dredged up, about 8 million m³ of which was needed to secure the zero-solution. Øresund also demanded the dredging of about 1.5 million m³ of sea-bed in compensation for the artificial peninsula and the artificial island at Peberholm. A total of about 7.5 million m³ of sea-bed was dredged up for the Øresund link.

7.1 Local changes

The environmental authorities feared that the major dredging and spillage of sea-bed material would perhaps cause permanent damage to the sea-bed close to two of the bridge constructions. That is why a requirement was set on a maximum of 5 percent spillage in the sea, of the material dredged up at the Øresund Bridge. The 5 percent requirement was satisfied and the damage done to the sea-bed was minor and of short duration. Continual monitoring of eel grass and common mussels showed that, after a general but minor decline, populations had recovered by the time the bridge was opened. Trends in bird-life were also observed. There was a minor downturn, e.g. in breeding eiders at Saltholm, during the construction period. The different bird populations have all returned to their normal sizes after completion of the Øresund Bridge. Overall, the environment paid a low price at Øresund and the Great Belt, because it was given consideration throughout the planning and construction phases of the bridges.

8 Heavy shipping around Denmark

Shipping traffic is heavy in Danish waters. The Belts and Øresund - the entrances to the entire Baltic region - bear heavy traffic. But shipping traffic also damages the marine environment. Pollution by oil and the bottom paints used on ships are especially problematical.

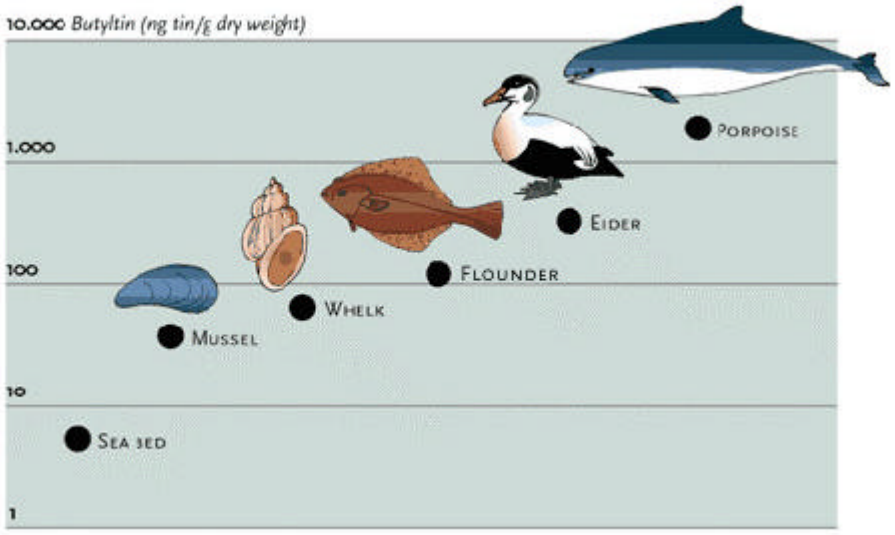
8.1 Oil pollution at sea

It is illegal to release oil into the seas around Denmark. Nevertheless, Admiral Danish Fleet receives about 450 calls a year on oil pollution events, of which half prove to be of no significance or erroneous. The oil primarily originates in ships' engine rooms, from which water contaminated with oil is released, and from oil tankers, which release rinsing water after cleaning their tanks. Every oil spill at sea threatens the marine environment. Ecologically important areas can be harmed and fish and bird populations can be impacted. Birds are probably the species most threatened by oil pollution, as their feathers (which constitute an effective water-repellent and layer of thermal insulation) are destroyed when birds come into contact with oil. In the winter, an oil spot the size of a large coin is sufficient to reduce a bird's insulation to the point at which it dies. However, oil normally degrades rapidly.

Aircraft and satellites regularly monitor the sea around Denmark. Furthermore, all ships navigating in Danish waters are obliged to report any pollution they observe. A sample is collected for chemical analysis when an oil slick is observed. The reason for this is that every type of oil has a characteristic composition - a kind of fingerprint. The next step is to take an oil sample from a suspected ship. If the two samples match, there are grounds for prosecution.

8.2 Ships' bottom paints contain toxins

Almost all ships are protected against fouling by algae, barnacles and other small creatures. This is done by adding various toxins - the so-called "biocides" - to the bottom paint. Without this treatment, a ship's bottom becomes overgrown, so that it loses speed and steerage way, while fuel consumption increases. For many years, the most important antifouling product has been copper-based paint, to which a number of ancillary compounds are added. In particular, tributyltin (TBT) has been used as an additive. TBT has proved to be extremely detrimental to the marine environment. It has been found to cause sexual disturbances in snails, resulting in hermaphroditism, even at ultra-low concentrations. Unfortunately, we find snails with these deformities everywhere in Danish waters, for instance in dog whelk and red whelk, both of which are severely affected. TBT also accumulates in the food chain and possibly constitutes a health risk to man and animals. Porpoises have been found to have such high concentrations of TBT that their immune defence has possibly been compromised.



Concentration of butyl tin compounds in different sectors of the marine food chain

The use of TBT on ships smaller than 25 metres is now prohibited in Europe, and work is in progress on an international ban for all ships from 2003. New and environmentally less hazardous ships' paints are fortunately emerging on the market. But many years will elapse before TBT entirely disappears. Large quantities of TBT are bound to particles in the sea-bed, where it degrades only slowly and continues to constitute a risk through potential uptake in the marine food chain.

9 Harbours as recycling centres

Danish harbours play a vital part in our efforts to secure a clean marine environment. Good waste reception facilities are decisive, if we are to prevent ships from illegally dumping their waste in the sea.

According to Danish regulations, all harbours must establish a scheme for receiving oil residues, sewage and other waste. Payment for ships' use of these facilities is based on the "no special fee" system. In other words, payment for depositing operational waste brought in by ships since the last time they called at a harbour is included in the harbour charges. This system encourages all ships to take advantage of the scheme. In addition, compulsory depositing of waste before ships leave harbour has been introduced throughout the Baltic area.

9.1 Depositing of sea-bed waste can harm the environment

Harbours and channels occasionally need dredging, because sandbars gradually build up. About five million tonnes of sea-bed waste is dredged up annually in Danish harbours. This waste is then transported to selected neighbouring areas and dumped. If the waste contains environmentally hazardous substances, such dumping can damage the marine environment. For this reason, dumping is only permitted for waste that contains insignificant quantities of hazardous substances, such as the heavy metals, oil residues and PCBs. These are substances that can accumulate in sediment - not least in harbours. The risk is that the substances will be picked up by turbulence in the water column and be absorbed into the marine food chains or by organisms in the sea-bed.

TBT is especially problematical. Concentrations of up to 20,000 times greater than are found in the sea-bed of the open sea have been found in sea-bed waste from harbours and channels. Instead of dumping in the selected areas, therefore, it could become necessary in the future to decontaminate and deposit much greater quantities of sea-bed waste than is the case today.

10 Marine wind turbines - a new source of energy

Fresh winds blow over Danish waters. This makes it tempting to erect wind turbines at sea. There is plenty of space and the noise of the generators is apparently not a disturbance at sea. Five wind power farms are planned for completion in Danish coastal waters by 2030, so that our wind turbines will supply 35 percent of Denmark's energy consumption, the major part by the above five farms. The goal is to reduce coal and oil consumption, thus reducing our contribution of CO_2 to the atmosphere and, therefore, enabling Denmark to contribute to reducing the greenhouse effect and global warming.

A decision has therefore been made to construct five test installations, each with about 80 giant wind turbines. Each installation will be able to produce about 500 mill. kilowatt hours, or the equivalent of the annual electricity consumption of 125,000 households. The first two installations at Horns Rev and Rødsand are expected to be finished within a few years. The test installations must manage their own engineering and economic conditions, which will be included in the assessment of the environmental impact of wind turbines in general.

10.1 Focus on effects

The main environmental benefit of marine wind turbine farms derives from their permanence as a source of energy. But such large installations can have negative effects on the environment during the construction and operating phases.

DEMONSTRATION PROJECTS – SITING OF WIND TURBINE FARMS IN DENMARK

The environmental effects are highly dependent on the location of the wind turbine farms. The first step is to perform an Environmental Impact Assessment (EIA). The EIAs for Horns Rev and Rødsand indicated limited environmental effects. The Rødsand area, where the sea-bed is particularly abundant and where many migratory birds and seals gather, is most exposed.

In fact, the foundations of the marine wind turbines will act as artificial reefs and will attract a wide variety of the animals and plants normally found on reefs - especially mussels which, in turn, attract fish and birds. In other words, we must decide whether or not we wish to attract flora and fauna that do not have their true habitats in these areas.

10.2 Birds and marine mammals

Marine wind turbines can possibly constitute a threat to migratory birds. The extent to which these birds would fly into the turbines - especially in poor visibility - is not known. Birds are therefore closely observed at Rødsand. All bird migrations are recorded and modelled under the conditions estimated to prevail when the turbines have been erected.

Such marine mammals as seals and porpoises will hardly be disturbed by the finished wind turbines, provided that the turbines are not sited at their breeding grounds. The underwater disturbance from the turbines is limited, and the magnetic field that surrounds the undersea transmission cable does not appear to disturb the animals significantly. Thus, there is much to indicate that marine wind turbines have only a limited effect on the marine environment. The continual nature and environmental monitoring of the first test installations will broaden our knowledge base in a few years' time.

11 International marine collaboration

The sea knows no boundaries - and neither does pollution. Minor contamination of our harbours is not merely a question of stopping our own discharges in Denmark. Rivers from many parts of East and Central Europe flow into either the North Sea or the Baltic Sea, with their content of nutrients and other environmentally harmful substances. Similarly, the atmospheric fallout that contaminates Danish waters has its origins all over Europe. In addition, there are the impacts of discharges from international shipping and oil spills. International collaboration is, therefore, quite decisive to our endeavours to obtain an unpolluted sea.

11.1 An unpolluted marine environment

Denmark's goal is that its clean-sea programme be completed by no later than 2020. This is also called a "generation goal," because Denmark - and the other North-Sea countries - have given themselves 25 years in which to attain the targets, starting from 1995. One of these targets is a marine environment without environmentally harmful substances, in which the occurrence of heavy metals has been brought down to the natural environmental background level. Another target is that the occurrence of nutrients be brought down to a level ensuring that oxygen depletion and toxic algal blooming only occur as the result of natural conditions.

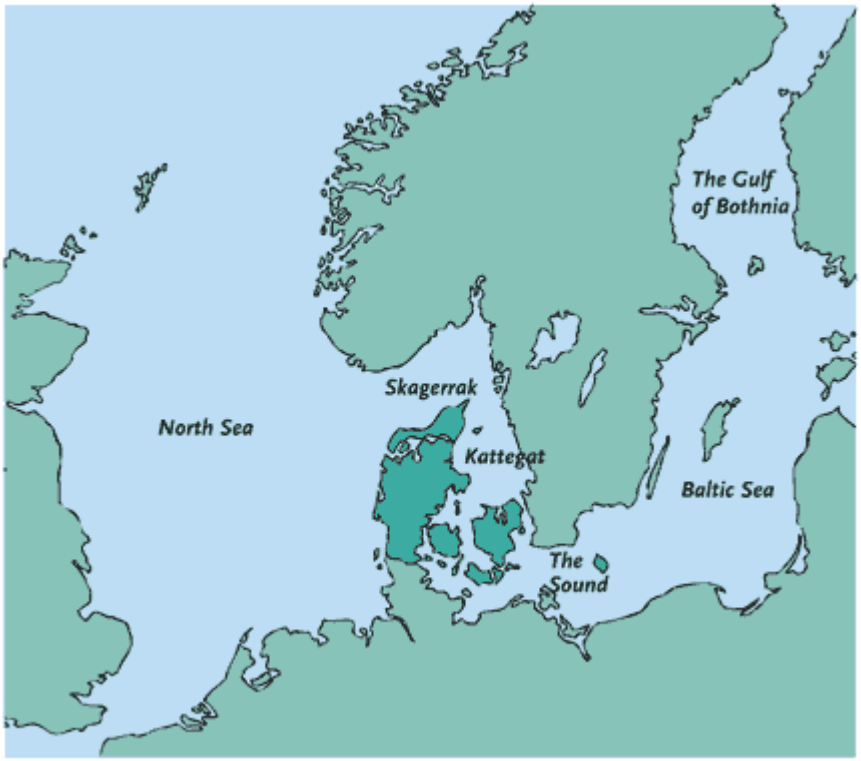
11.2 Marine conventions pave the way

These ambitious goals have their origins in the North-Sea conferences, at which the ministers of participating countries meet regularly, and in the international marine conferences, OSPAR and HELCOM (see the sidebar), at which the countries around the Kattegat, Baltic Sea and North Sea have described their strategies for a better marine environment.

The OSPAR Convention - has the task of formulating agreements on protecting the entire North-East Atlantic region, including the Kattegat, against all forms of pollution. This convention has been signed by all EU Member States, as well as Iceland, Norway and Switzerland.
HELCOM Convention - has the task of formulating agreements on protecting the Baltic Sea, including the Kattegat, and has been signed by the EU and the countries surrounding the Baltic Sea. HELCOM also covers shipping and is working, e.g., to improve harbour reception facilities for handling ships' waste and cargo residues.

The regional collaboration on protection of the environment serve as beacons for the individual countries' environmental legislation and initiatives in the

marine area. The agreements are of major political significance to these countries' national regulation of marine pollution. There is also broad co-operation on marine policy between the EU and OSPAR. Denmark gives high priority to the work of these conventions, e.g., by drafting new proposals for decisions and by leading the way, through incorporation of the agreements into Danish environmental legislation. Together with a Danish effort, the international marine agreements are crucial factors on the path to a clean marine environment. The goal of handing down an unpolluted sea to the next generation demands the backing of politicians and citizens alike.



New initiatives in regional forums on co-operation

· Reassessment of discharges from the reprocessing of nuclear fuels.
· Better reception facilities in harbours.
· Landing of decommissioned production platforms.
· Design of on-going environmental-status reports from signatory countries.
· Protection and preservation of ecosystems and biodiversity.
· Selection and prioritisation of the environmentally hazardous substances that we must stop discharging.
· Integration of environmental and sectorial policies, including policies on fisheries.

12 More information

12.1 Information and guidance

Miljøbutikken – Information and Books, phone: (+45) 33 95 40 00
butik@mem.dk
www.mem.dk/ukindex.htm

Danish EPA website:
http://www.mst.dk/homepage/

Danish Forest and Nature Agency website:
http://www.sns.dk/internat/internat.htm

Danish Energy Agency website:
www.ens.dk/uk/index.asp

National Environmental Research Institute website:
http://www.dmu.dk/1_english/default.asp

Helsinki Commission (HELCOM):
www.helcom.fi

OSPAR Commission:
www.ospar.org

12.2 Reading list

"Aquatic Environment 99" Ministry of Environment and Energy, 1999/2000, available in Miljøbutikken or on the Danish EPA homepage:
http://www.mst.dk/udgiv/Publications/2000/87-7944-087-8/html/default_eng.htm
"Algae at Danish Shores" - pamphlet from the Danish EPA, 1999, available in Miljøbutikken